

THE CONFLICT OVER THE WATER IN THE UPPER GUADIANA (SPAIN). POSSIBLE SOLUTIONS (CONWATER)

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ABSTRACT

The Upper Guadiana area in Spain is an example of the conflict that can be created by the use of water in a semiarid area. The serious problem posed at this time has to do with the agrarian model followed in the area, highly dependent on subterranean water, and its incomplete adaptation to the evolution of the natural environment, creating great sustainability problems. The solutions ought to develop a special Plan of the Upper Guadiana, that should consider at least the following strategic or instrumental objectives:

- To regulate the pumping of water and direct the progressive re-establishment of the natural hydrological function of the area.
- To design a new agrarian model with a multifunctional approach: A) Developing a management model of the available hydric resources, accepted by all concerned parties, and an effective control of the pumpings; B) Encouraging crops for dry farming and the social and economically efficient use of the water; C) Designing a program for integrated rural development.
- To provide the Plan with the necessary resources and tools for adequate management and follow-up, as well as that of the set of attached measures: a) the creation of a “bank of rights over the use of water”, managed by a partnership with the participation of the Public Administrations, irrigators, Universities, etc., which enables and speeds up the tasks to be done for the rearranging of the rights over the use of water; b) to develop models to aid in the decision-making process.

Key words: Water use, Irrigation, Wetland, Conflict solutions

ORIGIN OF THE CONFLICT

The development of the agrarian activity in large part of the arid and semiarid areas with limited water resources must lead to an increase in the efficiency of the management and use of the available water in order to serve an increasing demand in its different uses (urban, agrarian, environmental, etc.) The Upper Guadiana area in Spain is an example of the conflict that can be created by the use of water in a semiarid area, where the feasibility of agriculture depends greatly on the water. The serious problem posed at this time has to do with the agrarian model followed in the area, highly dependent on subterranean water, and its incomplete adaptation to the evolution of the natural environment, creating great sustainability problems.

The Upper Guadiana issues, and more specifically those of the Hydrogeological Units declared overexploited, have been dealt with on numerous occasions and from different points of view (Álvarez and Cirujano 1996, CHG 1996, Cruces et al. 1998., López 1998, Serna and Gaviria 1995, GRAPES 2000). One of the most recent works was carried out by Díaz et al (1999) who elaborated a report on a

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“Plan on the sorting of natural resources and sustainable development in the Upper Guadiana,” which contains research, diagnosis and a proposal on the proceedings in the matter.

Water resources available and their use in irrigation.

Although there are numerous aquifers from which water is being drawn up for irrigation at this time in Castilla-La Mancha, it is in the three biggest aquifers (08.29, 04.04 and 04.06) where the problem is most urgent since it holds 50% of the nearly 450.000 ha of irrigable lands.

The Upper Guadiana basin (fig. 1), with little more than 16.000 km², extends throughout the provinces of Albacete, Ciudad Real, Cuenca and Toledo, covered by a central plain where the La Mancha Occidental aquifer is located (Aquifer 23 or 04.04 under the new designation). This aquifer acts as a geological sewer for the Guadiana river, which disappears refilling the aquifer. The drainage system which comes from the Altomira Mountain Range through the Záncara and Cigüela rivers in the north and Montiel Fields through the Ruidera Lagoons and Azuer River in the south flows its water into the above mentioned plain. The great majority of those contributions filter into the aquifer which in turn flows into humid areas, among which Las Tablas de Daimiel stand out for their importance. Las Tablas de Daimiel were declared a Nature Reserve in 1973, expanded in 1980 and attached to the treaty of wetlands Ramsar, of international importance since 1982. This wetland, which during the 1960's kept about 6.000 hectares flooded, saw its flooded area cut down to less than 1.000 hectares at the beginning of the 1990's, during the most critical time of the drought. Something similar happened with the Guadiana Springs (Ojos del Guadiana), the aquifer's natural drainpipe, which has been dry since the beginning of the 1980's. The wetlands of La Mancha were considered a Biosphere Reserve by UNESCO in 1981.

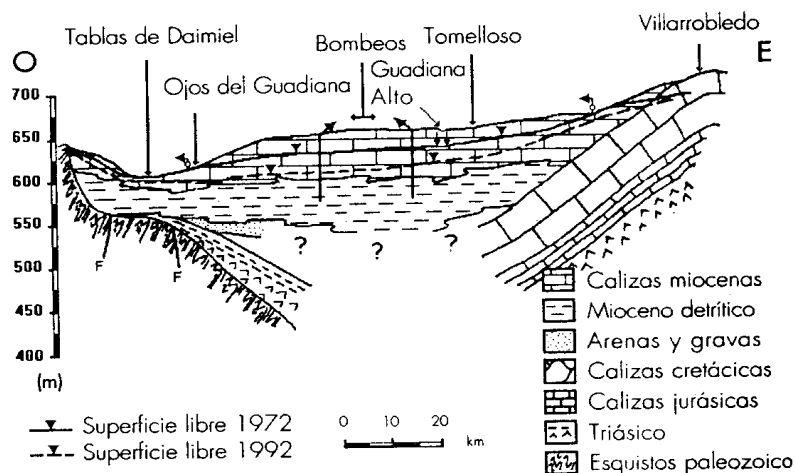
The process of agrarian intensification in the Upper Guadiana basin and specially the Hydrogeological Systems (H.S.) 04.04 and 04.06, is due mainly, to the use of groundwater for irrigation, but its indiscriminate use has affected the availability of the resource for irrigation itself, for the natural processes and for human needs. As an example, in figure 2 there is a diagram of the hydrogeological structure of H.S. 04.04.

Figures 3 show the situation of the piezometric levels in 1980, before the maximum extractions which take place at the end of the 1980's, and the situation of the piezometric levels in the year 1997, at the beginning of the extension of the Revenue Compensation Plan (PCR) started in 1992.

The Development, related mainly to the agrarian activity, certain industrial activities and hydraulic works, has also affected the quality of the natural resources and that of naturalistic aesthetic-cultural and tourist-recreational values linked to rivers and wetlands.



Figure 1. Main aquifers in Castilla-La Mancha



Fuente: García Rodríguez y Llamas, 1992.

Figura 2 Longitudinal cross section SW-NE del S.H. 04.04, and levels in 1972 y 1992.
(Cruces, 1998, from García Rodríguez, 1992).

The interests that fight for the control over the water in this territory are as varied as the uses, organizational structures, affected spaces and social perceptions linked to this resource. This number of factors does not aggravate the problem as much as the non-existence of adequate forums for the debate of those interests and the execution of agreements that enable reaching a situation of sustainable use of existing water resources.

In the plain of La Mancha, there has traditionally existed a use of the groundwater for agricultural purposes. It is estimated that at the beginning of the 1960's, in the Mancha Occidental Aquifer, there were 20000 ha irrigated with waterwheels which pumped between 50 and 100 hm³ of water annually.

Following several plans for agricultural development and cleaning of swamp lands, the irrigated land increases notably, going from about 30000 ha in 1974 to more than 125000 ha in 1987, with pumping of over 550 hm³. These numbers extensively excel the renewable resources of the aquifer, estimated to be between 200 and 300 hm³/per year in the Hydrological National Plan (HNP 2000) according to several sources, which caused the Mancha Occidental aquifer to be provisionally declared overexploited in February 1987, and with a final declaration in December 1994. In the same way, in April 1998, the Campo de Montiel aquifer (aquifer 24 or 04.06 under new denomination) where the irrigated area reached almost 8000 ha, was provisionally declared overexploited, with a final declaration in June 1989.

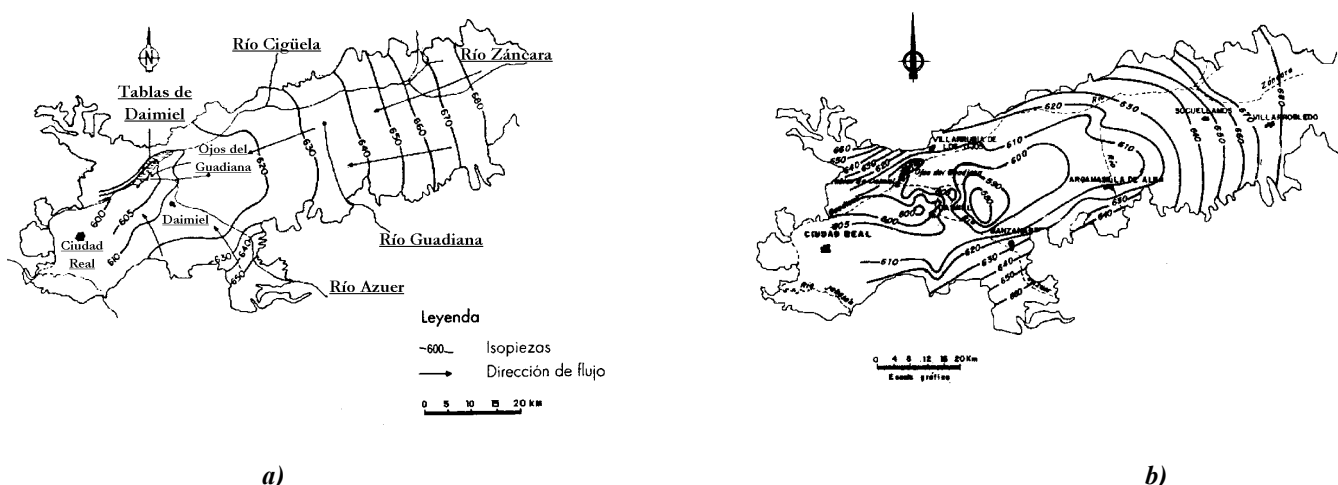


Figura 3. Piezometric diagram of the plain of La Mancha: a) September 1980 and b) February 1997. SGOP.

The restriction in the use of water was overtly unfulfilled, due initially to the loss of revenues it was causing. To solve the situation, in part, in 1992 the Agrarian Revenue Compensation Plan (RCP) is approved in the hydrogeological units Mancha Occidental and Campo de Montiel, extended in 1997 for five more years, establishing aids to irrigation farmers to introduce measures compatible with the preservation of wetlands, saving water during irrigation and changing these crops for others which consume less water.

In this way, the irrigated land in this area is subject to two types of limitations. On the one hand, we have the Operating Rule (OR), with obligatory compliance, determined by the Hydrographical Confederacy (HCG) whose basic objective is to reduce the pumping of water for the user (especially irrigators), to recover the water resources of the system. On the other hand, we have the RCP, who is after two main objectives: a) to maintain the agrarian activity and the farmer's income and b) to preserve the natural spaces in the area.

The average annual rainfall in the Guadiana upper basin is about 420 mm, and it ranges between 200 mm during the driest years and 600 mm in the most humid ones, the highest rates being in Campo de Montiel and Sierra de Altamira. The dry period being frequent and extending for 2 to 3 years.

The average annual contribution in a natural way to the Vicario dam (HNP 2000), water seal of the Guadiana upper basin, is around 300 – 400 hm³, equivalent to 15–20 mm/year, which means less than 5% of the total rainfall. 275hm³ of these, come from subterranean sources. The contributions represent a great year-on-year variability, fluctuating from less than 100 hm³/year during the dry years to more than 1000 hm³/year during the humid ones, which can justify the refilling works in strategic areas as an additional measure to overcome the great current hydric deficit.

HNP (2000) says that the Technical and Geomining Institute (ITGE, 1997) estimates the emptied reserve at 3125 hm³ in the aquifer 04.04 between 1980 and 1997. A similar conclusion is reached in the works carried out by the European project GRAPES, comparing the net pumpings (where a compensation of 10% is taken for granted) and the natural refilling. J.A. Fernández (2000) provides an update of this data, indicating that the emptied reserve in HS 04.04 between 1980 and 2002 can be about 2500 hm³ (fig. 4).

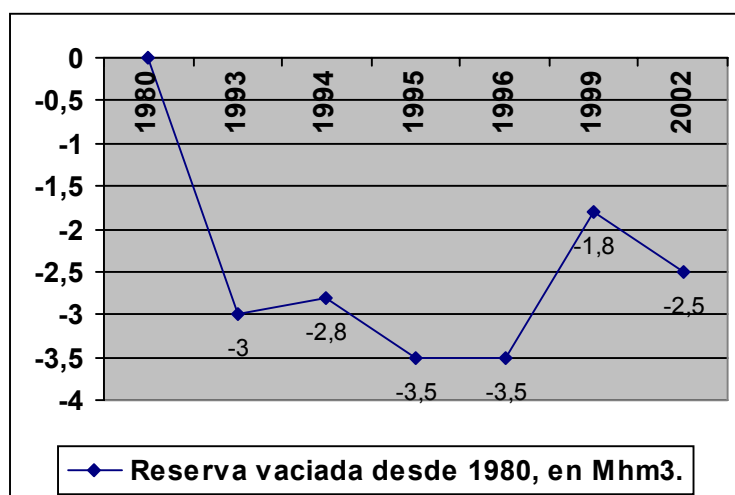


Fig. 4. Estimated of the emptied reserve in aquifer 04.04

As we can see in fig. 4, between 1996 and 2000 there is a drop in the pumpings, reaching about 250 hm³/year, with an average recovery of the aquifer of 2,52 m/year. This amount is similar to the 260 hm³/year average value of renewable resources available in the HS 04.04 established by the Hydrological Plan I of the Guadiana basin, and which is put forward as an objective in the declaration of overexploiting to obtain a balanced hydric equilibrium.

The theoretical savings obtained by applying the OR has been very important, estimated at about 210 hm³/year in the 04.04 and 21 hm³/year in the 04.06. This reduction increases about 47 hm³/year more by applying the RCP to the SH04.04, and about 4 hm³/year more by applying it to the HS 04.06.

From a global point of view, the application of the RCP seems only an immediate relevant measure, that has managed to make crops that need a lot of water disappear. Thus, possibly maintaining the farmer's income, but lowering the level of activity and dynamism of the area which could negatively affect its economic development.

According to the National Irrigation Plan (NIP, 1997), the annual hydric deficit in the HS 04.04 is estimated to be 240 hm³/year. This deficit means more than 30% of the total national deficit. A fact that indicates the difficult situation which the Hydrogeological systems, including said basin, are going through.

PROPOSITIONS AND REFLECTIONS IN SEARCH OF SOLUTIONS

The action taken must be in line with the solution proposed by the National Hydrolic Plan to develop a Special Plan of the Upper Guadiana (SPUG), which must deal with:

- The rearranging of the rights to use the waters, oriented towards the environmental recovery of the aquifers.
- The authorization of the modifications in the operating system of the existing wells.

- c) The granting of ground waters in times of drought.
- d) Other measures designed to obtain permanent hydric and environmental equilibrium in this basin.

We have thought up the following propositions and reflections with the only purpose being that of serving as support to the decision process when proposing sustainable farming in the Upper Guadiana, making the socio-economic development compatible with the conservation of the natural resources, and the preservation of the environment.

The new agrarian development model

The development of agrarian activity must lead to the increase in the efficiency of the management and use of available water, with the hydric equilibrium of the hydrological system. Therefore, the new agrarian development model demands, among other things:

- Developing a management model of the available hydric resources, accepted by all concerned parties, with the maximum consensus over the distribution of the rights over the water use and the effective control of the pumpings.
- Rebalancing the incentives between the different agrarian activities in the works, encouraging crops for dry farming and the social and economically efficient use of the water.
- Getting underway a program to support crops for dry farming, combining agro- environmental measures with those supporting underprivileged agrarian areas and others related to commercialization, education, etc.
- Designing a program for integrated rural development, emphasizing the consideration of natural resources, especially aquatic ecosystems.

Strategic objectives of the plan

With these considerations, the special Plan of the Upper Guadiana should consider at least the following strategic or instrumental objectives:

- To regulate the pumping of water and direct the progressive re-establishment of the natural hydrological function of the area. This requires starting from an inventory of uses and configuring an effective control system --pumpings, consumption, purification-- and the use of environmental and socioeconomic indicators for the follow-up of the recovery and improvement of the quality and use of the resource.
- To try to promote the profitability of the crops for dry farming in relation to that of irrigated crops, looking for distinguishing aspects linked to quality, specific nature, organic farming, etc. This is related directly to the assessment of the least water consuming crops and with the highest added value per m³ of water used.
- To design a new agrarian model with a multifunctional approach, which deals with the role of agriculture as a “supplier of environmental goods and services”, and the legitimacy of rewarding farmers for this operation.
- To provide the Plan with the necessary resources and develop tools that allow for the availability of the necessary information for adequate management and follow-up of the Plan finally adopted, as well as that of the set of attached measures.

Complementary Proceedings

Besides what has been previously indicated, we consider necessary:

- A) The creation of a “bank of rights over the use of water”, managed by a partnership with the participation of the Public Administrations, irrigators, Universities, etc., which enables and speeds up the tasks to be done for the rearranging of the rights over the use of water. In this sense, it is fundamental to define a quota of renewable water for agrarian use by areas (which wouldn't necessarily have to coincide with the different aquifers included in the Upper Guadiana), starting from the estimates of available and renewable resources in the Hydrological System of the Upper Guadiana. This quota could be reviewed every 5 or 10 years depending on the evolution of the System and it would allow a medium term perspective to make investments and plan the crops.
- B) To develop models to aid in the decision-making process, to study and assess alternative crops which allow the rebalancing between the different agrarian activities present in the Upper Guadiana, taking into account possible modifications in the agroenvironmental aids in the area, encouraging dry farming and the social and economically efficient use of the water. For this, it is necessary to carry out a set of studies from the foundation, such as:
 - 1. Making a proposition to divide the area of the Upper Guadiana into parts as homogeneous as possible in relation to the productive agrarian potential, where it is possible to apply in different ways, the different measures and actions dealt with in the SPUG.
 - 2. To typify the farms of the Upper Guadiana, as a foundation to apply criteria, measures and proceedings dealt with in the SPUG.
 - 3. Socioeconomic evaluation of the area, with special emphasis on the effects caused in the economy of the area by irrigation and the structural limitations which affect them.
 - 4. Assessment of the rights over the use of water to irrigate in the area.
- C) To look for alternatives to reduce water consumption and generate rights for the Management:
 - Reducing the irrigated area and/or water disponibility per hectare through the social and economic rearranging of the irrigated lands.
 - Generating hydric resources available for reclamation, purchase or expropriation of the rights over the use of water.
 - Introducing modifications in the most relevant agroenvironmental aids for the area, taking into account present and future crops (vineyards, olive trees, herbaceous plants, fruits and vegetables,...), taking into account three important aspects: a) the possibility of modulation (to avoid the concentration of aids for large landowners), b) flexibility and c) eco-dependency, under the obligation of introducing improvement processes for irrigation systems and their use (with the help of the Integral Service of Assessment for Irrigators, SIAR), carrying out good farming practices, participating in training, processes, etc.
- D) To study alternatives for the rearranging of the rights over the use of water in farming, according to different criteria (equity, efficiency,...) and parameters (crops, soil, size and type of farms,...) defining the criteria and priorities to have access to new rights, where possible solutions to irregular situations will be taken into account.

- E) To promote the role of irrigator's associations, clarifying their task, responsibility and commitment in the management of water: control, follow-up and observation of the water uses. For this, help will be needed in:
 - Developing and transferring of management tools (models and programs): Database, GIS, etc.
 - Training and information: courses, informative documents, access to the information on INTERNET through Web Sites containing information for irrigators, etc.
- F) To improve the efficiency of the use of water, continuing with the actions already under way for:
 - Improving and modernizing irrigated land
 - Advisory service for irrigators (SIAR)
 - Switching to less water-consuming crops (with greater added value per m³ of water)
- G) To do a follow-up of the development of the Special Plan of the Upper Guadiana through the following indicators:
 - Hydrological: evolution of the piezometric levels and hydric resources and their repercussion in the farm system (annual assignment of the available water).
 - Ecological: evolution in the quality of surface and ground water, state of the wetlands, etc.
 - Socioeconomic: developments in income, (farming and non-farming), employment, social status, etc.
- H) To define a general plan for artificial refilling of excess overflow during heavy rainfall, identifying previously the most suitable refilling areas. The works for "Reinforcement infrastructure of artificial refilling in the Upper Guadiana," to be carried out between 2001 and 2008, were declared of general interest by the HNP. It will be important to know their dimension and do a follow-up session.
- I) To define a complete plan to reuse waster waters.

One cannot end these reflections and propositions without pointing out that in order to carry out any Plan, it has to be endowed with the necessary financial resources, making use of those that can be obtained from the agroenvironmental program, reorienting its objectives to the consolidation of the reduction in pumping ground water, avoiding the concentration of aids, rationing irrigation, supporting dry farming and encouraging organic farming, as well as other rural development programs.

Propositions for farming in the XXI century

Future farming in the area must reach the objectives of sustainable farming, with low input production systems to minimize the use of production measures outside the farm (fertilizers, phytosanitary, etc), to reduce production costs, to avoid the pollution of superficial and ground waters, to decrease chemigation residues in food and the risks for farmers and to increase, in short and long-term, the profitability of the farm. In other words, to develop farming in relation to three core references: economic feasibility, ecological feasibility and social and generational fairness.

The framework under which the new irrigation plan is established must take into account:

- The strategic importance of irrigation for the consolidation of the food and agricultural system in the area.
- The price and subsidies policies indicated by PAC, which will determine a big part of the global farming strategies, having to produce the market demands as far as the quantity, quality and dates, making the best possible use of weather conditions and existing profitable structures.
- The modernization of current irrigated land, enabling its adaptation to new profitable directions and favouring the saving of water.
- The promotion of commercialization and marketing, as well as the industrial transformation of the productions, as a strategy to take over new markets and increase the added value of agrarian production. An essential pillar must be the safety of food and the traceability of the productions, with the corresponding certifications which favour the commercialization channels, without forgetting the potentiality of organic farming and other varieties.
- The promotion of the removal of irrigated land, as a voluntary act, temporary or permanent, of those less-producing farms, to favour the rebalancing of hydric resources.
- The dedication of agrarian investigation efforts for fruit and vegetable crops irrigated with controlled deficit, and for the use and application of irrigation water in an efficient way, thus creating a web of information and advice with the help of the Geographic Information Systems (GIS), remote sensing, SIAR, etc. as a means of support for the management and the efficient use of water, on the part of the Agrarian Administration as on the part of Professional Organizations and Irrigator's Associations.

The solutions for dry farming can be:

- To try to diversify farming alternatives with leguminous grains for human consumption (lentils and chickpeas) as well as animal consumption (protein peas, vetch and lentils), with oily products (colza and sunflower) and with other winter cereal (durum wheat).
- To extend the production systems into the multiplication of seeds (production of certified seeds), of cereal (oats, etc.), leguminous grains (vetch and lentils) etc.
- To integrate stockbreeding with agriculture (production of fodder).
- To act on crops with special social repercussions: vineyard (new crops and managing techniques) and olive trees.
- To introduce crops to obtain starch, gluten, fibre, alcohol and other raw materials currently considered "subproducts": hemp, linseed, Jerusalem artichoke, thistle, etc.
- To promote aromatic and medicinal plants (for example: opium plant).
- To afforest land with low productive potential or high ecological value.

The solutions for irrigation could be:

- To go to sustainable production systems which improve the efficiency in the use of water: species, variety and techniques and to go to herbaceous and woody crops which allow planning irrigation with controlled deficit.

- To select alternatives for crops which are adequate for the availability of water, the agroclimatic conditions and market opportunities, emphasizing crops typical of the Spring cycle, favoured by the Agenda 2000, such as: legumious grains (protein peas), oily products (colza and mustard) and wheat.
- To promote extensive horticulture with short-cycle crops and double use (fresh consumption and industrial transformation): broccoli, cauliflower, radish, lettuce (iceberg and baby types), spinach, endives, green beans, sweet corn and English peas.
- To keep a minimum of sugar beet in the area.
- To generate a system of foraging production, with prairies and annual Spring or Autumn crops, for grazing, haymaking and ensiled in bags, based on crops such as: vetch-oat, foraging maize, foraging turnip, foraging cabbage, foraging colza, italian raygrass, westwoldicum raygrass, etc.
- To improve the alternatives for traditional horticultural crops: “harsh skin” melon, “tendral” melon, “rochet” melon, pepper, aubergines, garlic, onions, potatoes, with techniques such as, padding or tunneling which will allow moving up the sowing time or planting and the use of short cycles adapted to the market need at all times.
- To stimulate intensive family horticulture with unnatural and semi- natural techniques: padding of the soil, small tunnels, macrotunnels and greenhouse-tunnels.

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